MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-27-R-9 Name Rock Creek Creel Census

Job No. I Title Summer Census

Period Covered July 1, 1967 - June 30, 1968

Abstract:

A creel census study to determine the contribution of catchable-size rainbow trout was continued for the tenth year on a 40-mile section of Rock Creek near Missoula, Montana. Fishing pressure and catch estimates were obtained by a regression analysis of complete car counter data and data from checking station contacts on randomly selected dates during the summer fishing season.

An estimated 8,448 anglers fished a total of 30,831 hours and caught 26,025 fish during the 1967 fishing season.

The average catch per man hour during the initial three years of the study (with fish stocking) was 0.92. The average catch per man hour during the next four years (without fish stocking) was 0.68. Rock Creek was stocked with 30,089 catchable rainbow trout during the 1967 fishing season and the average catch per man hour was 0.84.

The first year return of trout stocked during 1958, 1959 and 1960 ranged from 34.3 - 40.1 percent and averaged 37.9 percent. The return to the creel of hatchery trout stocked in 1965, 1966 and 1967 was 35.5, 51.4 and 37.6 percent, respectively, for an average of 41.5 percent.

Recommendations:

To fulfill the basic objectives of the study, the following is recommended:

1. The field study be discontinued.

2. A complete analysis of census data from the ten years of study be made. Pertinent aspects of the study should be compiled into a ten-year summary report.

Objectives:

The long-range objective of the Rock Creek study is to obtain the necessary harvest and pressure information for an evaluation of the stocking program of catchable-sized rainbow trout in Rock Creek. This report covers the tenth year of the study. A final objective should be to assemble the data into a comprehensive, usable form.

Techniques used:

Basic techniques were the same as in previous years with the following exceptions: The fishing season began on May 21 and ended November 30, a total of 194 days. However, on August 24, 1967 the Lolo National Forest portion of Rock Creek was closed to all recreational use because of extreme fire danger. The Lolo National Forest includes all but about seven miles of the 40-mile study area of Rock Creek. This seven mile area is within the Deerlodge National Forest and remained open until August 30, when it was also closed to travel. The fire closure extended until September 11, 1967, at which time the entire length of Rock Creek was reopened to recreational use. During these closed periods both checking stations were inoperative, and the traffic counters tallied only non-fishermen traffic.

The lower station was reopened when the fire closure was lifted and remained open until November 30. The upper station officially closed September 5 because of very low fishing pressure, however, no fishermen contact information was obtained after August 26, 1967. Between opening day and their respective closing dates, 73 days were censused at the lower station and 51 days at the upper station. This does not include those scheduled census days which were not worked because of fire closures. The days censused are shown in Appendix A.

Estimates of fishermen, hours, and fish which were lost during the 18-day fire closure at the lower station were made so that a total seasonal estimate could be obtained and compared with previous years. These estimates were made by (1) determining the average car count per day at the lower station (105 cars), then (2) determining from the estimated census data the corresponding number of fishermen, hours, and fish for a day with about 105 cars. (This is, in effect, the same process as taking these data from the linear regression curve fitted to the known data). These data for the lower station are:

Ave. car count	Fishermen	Hours fished	Fish harvested
105	29	111	89

Each of these figures was then multiplied by 18 days, for an estimate of the potential number of fishermen, hours fished and fish harvested during the closure.

No estimates were made of fishermen, hours and fish during the brief fire closure at the upper station since it was believed to be insignificant in the

total analysis.

Another technique used this year which differed from previous years was a change in the hours of census. In previous years the census day ran from 9 a.m. - 9 p.m. Mountain Standard Time. This year Daylight Saving Time began on May 1, 1967. Legal hours of fishing were changed from 5 a.m. - 10 p.m. (MST) to 5 a.m. - 11 p.m. (DST) to compensate for the lengthened daylight period. Checking stations were operated from 9 a.m. - 9 p.m. from opening day until August 2. During this period five periodic checks were made at the lower station to determine the number of fishermen leaving the Rock Creek area before 10 a.m. and after 9 p.m.. It was found that very few fishermen left the area before 10 a.m. but sufficient late fishermen were contacted after 9 p.m. to warrant a change in the hours of census. Consequently on August 2 the hours of census were changed to 10 a.m. - 10 p.m. (DST). It is believed more complete contact data was obtained with this time schedule. Table 1 shows the number of contacts made before 10 a.m. and after 9 p.m. for certain census days.

Table 1. Number of cars and fishermen contacted, hours fished and fish caught before 10 A.M. and after 9 P.M. Daylight Saving Time at lower Rock Creek station - 1967

Date	No. cars	No. fishermen	Hours fished	Fish caught
		Before 10 A.M.		
5-22	1	1	2	0
7-20	0	0	0	0
7-26	0	0	0	0
7-28	0	0	0	0
7-30	1	2	4	0
Total	2	3	6	0
		After 9 P.M.		
5-22	Not checked			
7-20	17	34	113	155
7-26	19	37	103	150
7-28	13	30	93	82
7-30	14	22	91	81
Total	63	123	400	468

An estimate was made at the lower station of fishermen contacts which were lost before the census time schedule was changed to compensate for Daylight Savings Time. Estimates were made only for evening contacts after 9 p.m., since the few morning contacts made before 9 a.m. were considered insignificant.

Cars counted by traffic counter and cars actually contacted from 9 p.m. - 11 p.m. on the days listed in Table 1 were compared. It was found that 33 percent of the total cars counted stopped at the checking station. A total of 2,274 cars were counted by the traffic counter from 9 p.m. - 11 p.m. May 21 - August 1. Therefore 33 percent, or 750, were fishermen cars. From the data in Table 1 it was determined that each car contacted contained an average of 2.0 fishermen. On the average each fisherman fished 3.2 hours and caught 3.8 fish. Therefore, an estimated 1,500 fishermen (2.0 x 750) would have been contacted after 9 p.m. from May 21 - August 1. These fishermen would have fished 4,800 hours and caught 5,700 fish. Confidence limits at the 95 percent level were placed around these estimates by the method used for the Georgetown Lake winter creel census to estimate fishermen from car counts (See job completion report F-12-R-13 Job 2, pg. 12-17). These ratio estimates and confidence limits were added to those for the known data and regression estimates in Appendix B. No estimates for this period were made for the upper station.

In 1967, 30,089 clipped catchable hatchery rainbow trout were stocked in Section 1 of Rock Creek. Again as in 1965 and 1966 no hatchery fish were stocked in Section 2. The 1967 fish planted were marked by an adipose-right ventral fin clip. This was the third consecutive year of fish stocking following four years without stocking.

As in the two previous years, the total plant of hatchery fish was distributed at 14 points along Rock Creek from the mouth up to the Tekoa cable crossing. No fish were planted above this point in 1965, 1966 or 1967. In 1967, one half, or about 15,000 catchables were stocked on June 26, 27 and 28. The remaining fish were stocked on July 17, 18 and 19. Each plant of 15,000 fish was distributed among the 14 stocking areas (Table 2).

Table 2. Planting sites on Rock Creek, Section 1, 1967

Planting site	Road mileage from previous location	Road mileage from lower checking station
Above first diversion canal	0	0.7
Valley of Moon Bridge	0.6	1.3
Rocky Pt. where Rock Creek is perpendicular to road	1.1	2.4
Spring Creek area	1.4	3.8
Public Access (vehicle) below Hamm Ranch	3.4	7.2
Ranch Creek area	3.5	10.7
State cabin area	1.1	11.8
Dalles campground	1.6	13.4
Tallus slope above Dalles	1.1	14.5
Harry's Flat	1.2	15.7
1 mile above Cinnamon Bear Cr.	1.2	16.9
Walquist Cable Crossing	2.1	19.0
Rock slide above Bitterroot Flats campground	2.9	21.9
Tekoa Cable Crossing	1.0	22.9

Minor difficulties with traffic counters at both stations occurred this year. At the lower station the counter was inoperative for several hours on May 23, May 24, June 15, August 6, August 18 and October 27 and 28. Estimates for short periods of no count (2-4 hours) were made by averaging the count two hours before and two hours after the affected period. For longer periods (more than 4 hours) the estimates were made by averaging the counts from the same periods the day before and day after the period of no count. If two or more consecutive days of no count were involved, or portions thereof, the estimates for those days, or portions thereof, were made by averaging the known counts from the same day of the previous and following weeks.

At the upper station the counter was inoperative on May 25, 26 and 27, and June 15. A partial count was available May 25 and 27. No count was available on May 26. Since this was during the first week of the fishing season and no previous week's data was available the estimates for May 25 and 27 were made by averaging the counts from the same periods of May 23 and 24 and adding them to the known counts for May 25 and 27. For May 26 the estimate was made by averaging the counts from the two previous days and from the same day the following week. No separate estimates of fishermen, hours, or fish were made for these periods of estimated car counts. They are combined in the estimates obtained by regression analysis.

The same creel census form used in 1966 was used again in 1967. Less emphasis was placed in completing the last two columns (Species Unknown and Caught & Released) since an analysis of 1966 data showed no significant difference in estimates of fishermen, hours, and fish with or without these factors (See Job Completion Report F-27-R-8, pg. 3).

A summary of the average sizes of hatchery rainbow planted in Rock Creek during the 10 year study is presented in Table 3.

Table 3. Number, weight and size of marked hatchery rainbow stocked in both sections of Rock Creek from 1958 through 1967.[1/]

Year	Number stocked	Total weight (lbs)	Ave. no./lb.	Approx. Ave. length (in.)
1958	34,195	7179	4.76	8.00
1959	26,765	5775	4.63	8.25
1960	28,917	6590	4.39	8.25
1965	5,000	1960	2.55	10.00
1966	10,087	2850	3.54	9.00
1967	30,089	8350	3.60	9.00

[1/] No fish were stocked from 1961-1964 inclusive

The method used in calculating the return of hatchery rainbow stocked each year and during preceding years, if any, is based on a direct proportion between number of hatchery rainbow checked in the creel, the number of census days involved, and the number of fishing days in which hatchery fish were available to the angler. The proportion is as follows:

$$\frac{\text{No. hatchery fish checked}}{\text{Corresponding no. of census days when hatchery fish available } \underline{1}/} = \frac{(x)\ \text{Total estimated hatchery fish}}{\text{No. fishing days when hatchery fish available } \underline{2}/}$$

EXAMPLE (1967 data)

Station #1	Station #2
$\frac{3748}{54} = \frac{x}{158}$	$\frac{68}{32} = \frac{x}{158}$
$54x = 592,184$	$32x = 10,744$
$x = 10,966$ fish	$x = 366$ fish

Total both stations = 11,302 fish = 37.6%

Findings:

Six species of game fish were taken by anglers in 1967. These were rainbow trout (Rb), Salmo gairdneri Richardson; cutthroat trout (Ct), Salmo clarki Richardson; brown trout (LL), Salmo trutta Linnaeus; Dolly Varden (DV) Salvelinus malma (Walbaum); brook trout (Eb), Salvelinus fontinalis (Mitchill); mountain whitefish (Wf), Prosopium williamsoni, (Girard).

The species composition of the catch from 1958 through 1967 is given in Table 2. The most apparent change in species composition is the reduction of natural rainbows in the total catch during years of fish stocking. However, if the hatchery rainbows are deleted, there is less variation in catch composition of natural rainbow trout with and without stocking (Table 3).

In 1967 the percent of natural rainbows in the total catch decreased to the lowest level found during the study. Hatchery rainbows comprised the largest percent found during the study. When the hatchery rainbows are deleted the catch of natural rainbows was slightly higher than in 1966.

The percent of cutthroat trout and whitefish in the creel decreased again in 1967 (Table 3). Brook and brown trout increased while Dolly Varden remained unchanged in the catch. The brown trout continues to increase in the catch. This increase is probably related to the steadily improving Clark Fork River as a brown trout fishery.

1/ Total census days in the season at lower station = 73. Number of census days between opening day and time of first hatchery plant = 19. Therefore, 73-19 = 54, the number of census days when hatchery fish were available.

2/ Total fishing days in season = 194. Number of fishing days between opening day and time of first hatchery plant = 36. Therefore, 194-36 = 158, the number of fishing days when hatchery fish available.

Table 2. Species composition of the anglers catch, in percent, from both sections of Rock Creek in the years 1958-1967.

Year	Hatchery Rb	Natural Rb	Ct	Eb	DV	LL	Wf
1958	26	38	7.3	15	5.0	1.2	7.0
1959	24	39	5.8	14	4.7	1.4	11.0
1960	25	34	8.0	13	5.2	1.9	13
1961	2.9	46	12.0	13	6.9	4.3	16
1962	1.3	53	8.6	12	5.5	4.9	15
1963	1.3	48	12.0	11	6.6	7.3	14
1964	tr.	53	10.0	11	4.8	7.2	14
1965	5.7	48.2	10.2	10.8	4.8	6.6	13.5
1966	16.6	39.3	7.3	10.6	6.4	8.7	11.1
1967	36.9	30.1	4.9	9.0	4.8	7.6	6.7

Table 3. Species composition of the anglers catch, in percent, exclusive of the hatchery rainbows, from both sections of Rock Creek during the years 1958-1967.

Year	Rb	Ct	Eb	DV	LL	Wf
1958	52	10	20	6.8	0.2	9.5
1959	52	7.6	18	6.2	0.2	14
1960	45	11	17	7.0	0.2	17
1961	46	12	13	6.9	4.3	16
1962	53	8.6	12	5.5	4.9	15
1963	48	12	11	6.6	7.3	14
1964	53	10	11	4.8	7.2	14
1965	51.1	10.9	11.4	5.1	7.1	14.4
1966	47.1	8.7	12.7	7.7	10.4	13.3
1967	47.7	7.8	14.2	7.7	12.0	10.6

The estimates of harvest in numbers of fish, pressure in man-hours and man-days are found in Appendix B. Confidence limits at the 95 percent level have been applied to these estimates. Because fishing pressure at the upper station was extremely low after September 5, no estimate of pressure, hours, and harvest was made after that date, as it would not significantly affect the overall results.

Correlation coefficients (r) showing the relationship between cars counted by traffic counter and each of the other variables (fishermen, hours, fish) are also shown in Appendix B for each station.

Trends in catch per hour, catch per angler and average length of trip since 1958 are shown in Table 4.

Table 4. Average catch per hour and per trip, and the average length of trip for both stations of Rock Creek, 1958-1967.

Year	Catch per angler	Catch per hour	Combined catch per hour	Average length of trip (hours)
1958	3.39	0.91		3.7
1959	3.07	0.94	0.92	3.5
1960	3.13	0.93		3.3
1961	2.23	0.75		2.9
1962	2.05	0.70	0.68	3.0
1963	2.04	0.64		3.2
1964	2.34	0.62		3.8
1965	2.35	0.67		3.5
1966	2.29	0.62	0.70	3.7
1967	3.08	0.84		3.6

Based on a known return of 3,816 hatchery fish, it is estimated that 11,302 or 37.6 percent of the 1967-stocked fish were returned to the creel in the first year (Table 5). Hatchery rainbows comprised 36.9 percent of the total catch in 1967 compared with 16.6 percent in 1966. It would appear that the high catch of hatchery fish resulted in the reduction of natural rainbow trout in the catch. Natural rainbows made up a lower percentage of the catch in 1967 than in all the previous years of the study (Table 2). This is perhaps due to stocking a large number of hatchery rainbows (30,000) in Section 1 only, rather than in both sections as was done from 1958 through 1960.

Table 5 also summarizes the estimated number of fishermen, hours fished, and fish harvested and number of fish stocked since 1958.

The percent return of 1965 and 1966 stocked rainbow in 1967 is as follows:
1965 stocking. Three (3) hatchery rainbows were checked at the lower station and none were checked at the upper station in 1967. The accumulated return of these fish from both stations through 1967 is given below.

Percent return in 1965	=	35.5
Percent return in 1966	=	7.0
Percent return in 1967	=	0.2
Total return		42.7%

1966 stocking. One hundred (100) hatchery rainbows were checked at the lower station and two (2) were checked at the upper station in 1967. The accumulated return of these fish from both stations through 1967 is given below.

Percent return in 1966	=	51.4
Percent return in 1967	=	2.7
Total return		54.1%

Table 5. Estimated number of fishermen, hours fished, and fish harvested, number of hatchery fish planted and their percent return from Rock Creek, 1958-1967.[1]

Year	Fishermen	Hours	Fish	No. hatch. fish stocked[2] Sec. 1	No. hatch. fish stocked[2] Sec. 2	% return (1st year) of hatchery fish
1958	14,800	55,300	50,300	21,795	16,400	34.3
1959	14,920	48,894	45,809	14,330	12,435	39.3
1960	14,563	49,104	45,537	19,917	8,955	40.1
1961	11,278	33,367	25,144	none	none	-
1962	12,399	36,450	25,457	none	none	-
1963	10,110	32,178	20,665	none	none	-
1964	9,258	34,887	21,637	none	none	--
1965	9,961	35,174	23,439	5,000	none	35.5
1966	10,117	37,661	23,210	10,087	none	51.4
1967	8,448	30,831	26,025	30,089	none	37.6

1/ 1960-1962 figures are revised data and differ from those found in completion reports for those years. See explanation in F-27-R-4 completion report (pg.7) covering period July 1, 1962-June 30, 1963.

2/ Numbers are from D-J Completion reports for respective years.

The catch per hour (CPH) of 0.84 in 1967 was higher than the CPH of 0.62 in 1966. As shown in Table 4, the combined CPH in 1965 through 1967 was slightly higher than the CPH for the years 1961 through 1964 when no fish were stocked. The average catch per angler increased over that for 1966. Average length of trip remained relatively unchanged from 1966.

The rate of catch of natural and hatchery rainbows and other game fish combined from 1958 through 1967 is shown in Figure 1. The overall catch per hour generally increased when hatchery fish were stocked with the exception of 1966 when it was as low as any year without stocking. Figure 1 shows that the increase in overall catch rate in 1967 was due primarily to the increase of hatchery rainbows in the catch. The catch rate of natural rainbows remained the same as in 1966. Only a slight decrease was noted in the catch rate of other game fish combined in 1967.

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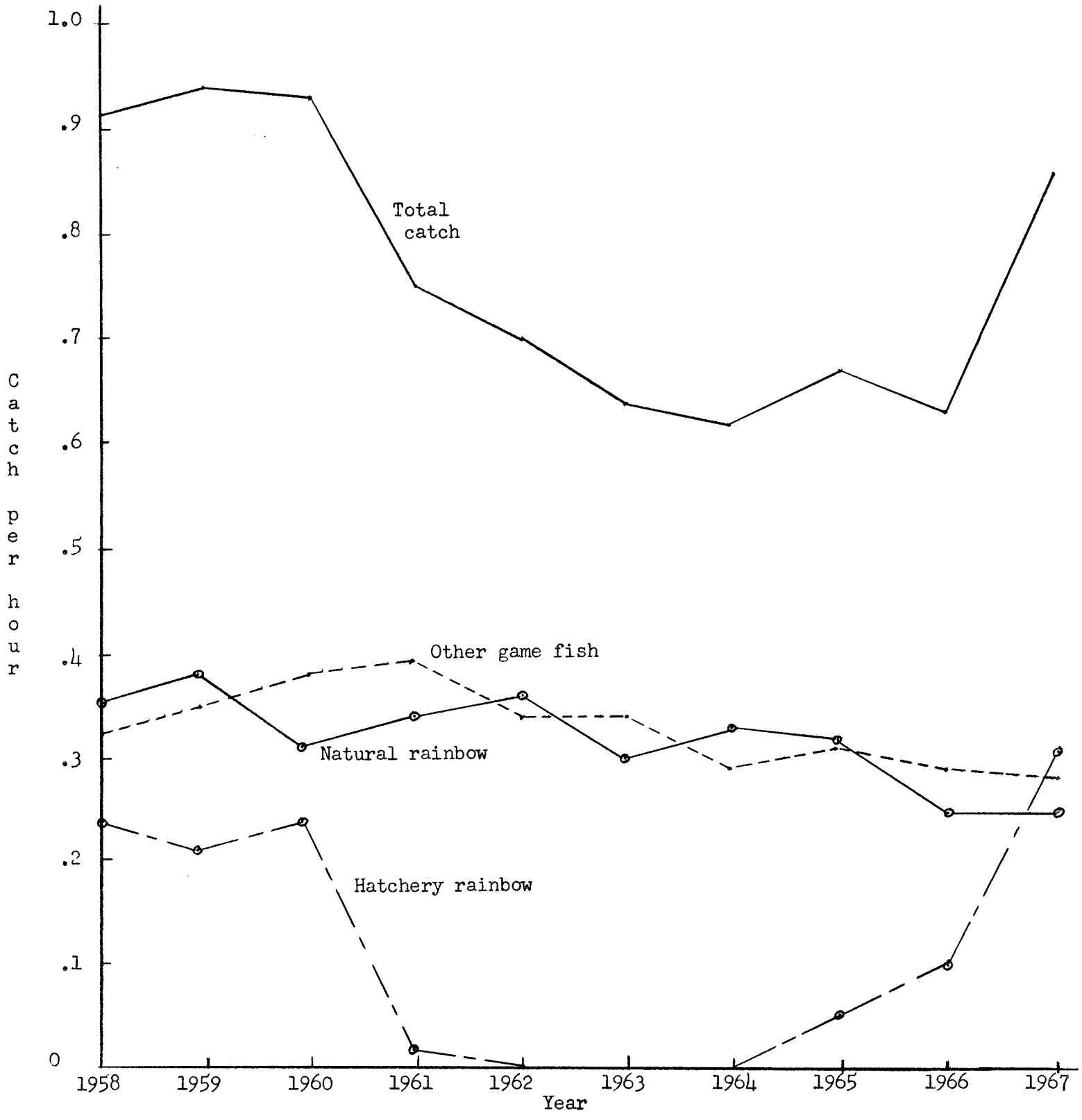

Figure 1. -Rate of catch in numbers of fish per man-hour for both sections of Rock Creek during the years 1958 through 1967.

APPENDIX A

Rock Creek creel census schedule - 1967[1/]
(Dates shown are census days)

Lower Station

May

- - - - - - - - - -- -- -- -- -- -- -- -- -- -- -- 21 22 -- 24 -- 26 -- 28 -- 30 --

June

1 - 3 - 5 - 7 - 9 -- 11 -- -- -- 15 -- 17 -- 19 20* 21 -- 23 -- 25 -- 27 -- 29 --

July

1 - 3 4 5 - 7 - 9 -- 11 -- 13 -- 15 -- 17 -- 19 -- 21 -- 23 -- 25 -- 27 -- 29 -- 31

August

- 2 - 4 - 6 - 8 - 10 --12 -- 14 -- 16 -- 18 -- 20 -- 22 -- -- -- -- -- -- -- -- --

September

- - - - - - - - - -- 11 -- 13 -- 15 -- 17 -- 19 -- 21 -- 23 -- 25 -- 27 -- 29 --

October

1 - - 4 - - 7 - 9 -- -- -- -- -- 15 -- -- -- -- 20 21 -- -- -- -- 26 -- -- 29 -- --

November

- - - 4 - - - - - 10 -- 12 -- -- -- -- -- 18 -- -- -- -- -- -- -- 26 -- -- -- --

*Substituted for 6-13

1/Fire closure in effect from August 24 through September 10. No census was conducted during this period, since no recreational entry was allowed into Rock Creek.

APPENDIX A (continued)

Rock Creek creel census schedule - 1967[1/]
(Dates shown are census days)

Upper Station

May

- - - - - - - - - - -- -- -- -- -- -- -- -- -- -- -- -- -- 21 -- 23 -- 25 -- 27 28 -- 30 --

June

1 - 3 - 5 - 7 - 9 -- 11 -- 13 -- 15 -- 17 -- 19 -- 21 -- 23 -- 25 -- 27 -- 29 --

July

1 - 3 4 - 5 - 7 - 9 -- 11 -- 13 -- 15 -- 17 -- 19 -- 21 -- 23 -- 25 -- 27 -- 29 -- 31

August

- 2 - 4 - 6 8 - 10 -- 12 -- 14 -- 16 -- 18 -- 20 -- 22 -- 24 -- 26 -- -- -- -- --

September

- - - - - - - --

[1/] Fire closure in effect from August 30 through September 11. No census was conducted after August 26 and station was closed September 5.

APPENDIX B

Estimates of game fish harvest, hours fished and angler trips with confidence intervals at the 95 percent level, for Rock Creek, Lower Station, 1967.[1/]

	Lower limit	Point estimate	Upper limit
Harvest:			
Regression estimate*	6829	8964	11099
Known	9576	9576	9576
Ratio est. 5-21 to 8-1 (after 9 p.m.)	5073	5700	6327
Total	21478	24240	27002
Hours:			
Regression estimate*	7928	10329	12730
Known	13257	13257	13257
Ratio est. 5-21 to 8-1 (after 9 p.m.)	4271	4800	5328
Total	25456	28386	31315
Anglers (man-days):			
Regression estimate*	2301	2839	3377
Known	3333	3333	3333
Ratio est. 5-21 to 8-1 (after 9 p.m.)	1335	1500	1665
Total	6969	7672	8375

*Includes fire closure estimate of:

Harvest - 1602
Hours - 1998
Anglers - 522

[1/] Formula for calculation of confidence intervals (Reference - Snedecor, George W. 1950. Statistical Methods. 4th Ed. Iowa State College Press, Ames. Pg 120.):

1. $S_{\hat{y}} = \sqrt{s^2 + \frac{s}{n} + \frac{(\text{estimated total} - \bar{x})^2}{n}}$

2. Upper and lower limits = $N \pm t_{.05} \times S_{\hat{y}}$

Where

$S_{\hat{y}}$ = predicted standard error

s^2 = variance for each variable (fishermen, hours, or fish) obtained from multiple regression analysis

n = number of days with known data (census days, opening day included)

estimated total = total fishermen, hours, or fish estimated by car count for non-census days (obtained from regression analysis)

$\bar{x}$ = total mean daily number of fishermen, hours, or fish (obtained from regression analysis)

N = point estimate of each variable (obtained from sum of known and estimated data)

* * * * * *

Correlation coefficient (r) showing the relationship between cars counted and each of the three other variables (fishermen, hours, fish) Rock Creek, Lower Station, 1967

	Cars
	r
Fishermen	.8770
Hours	.8947
Fish	.8561

Appendix B (continued)

Estimates of game fish harvest, hours fished and angler trips with confidence intervals at the 95 percent level for Rock Creek, Upper Station, for the period May 21 through September 5, 1967.[1]

	Lower limit	Point estimate	Upper limit
Harvest:			
Regression estimate	581	798	1015
Known	987	987	987
Total	1568	1785	2002
Hours:			
Regression estimate	751	1034	1317
Known	1411	1411	1411
Total	2162	2445	2728
Anglers (man-days):			
Regression estimate	244	336	428
Known	440	440	440
Total	684	776	868

[1] Formula and reference for confidence interval calculation are same as for Lower Station.

* * * * *

Correlation coefficients (r) showing relationship between cars counted and each of the three other variables (fishermen, hours, fish) Rock Creek, Upper Station, May 21 through September 5, 1967.

	Cars
	r
Fishermen	.6346
Hours	.4927
Fish	.6404